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A NEW ENDELOCRINUS FROM THE BRUSH CREEK LIMESTONE (PENNSYLVANIAN) OF PENNSYLVANIA

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Identifiable crinoid specimens from the Brush Creek Limestone, Conemaugh Group, Pennsylvanian, are rare, and none has been described previously. During the summer of 1962 I collected the crown of a specimen of *Endelocrinus* from the Brush Creek Limestone near Murrysville, Pennsylvania. The specimen, which appears to represent a new species, is described in the following pages.

Several institutions and their representatives have aided me in this investigation by permitting me to study collections or by loaning specimens for comparison. These include Carnegie Museum and Dr. E. R. Eller; the Illinois Geological Survey and Mrs. Lois S. Kent; Ohio University and Dr. Myron T. Sturgeon; Orton Museum of the Ohio State University and Mr. Thomas J. M. Schopf; and the United States National Museum and Dr. Porter M. Kier.

I wish to thank Mr. Calvin Colson of Ohio University for photographing the specimen, and Mr. Harold J. Flint of the Ohio Geological Survey for preparing the illustrations.

The holotype, which is derived from my personal collection, has been presented to Carnegie Museum.

Systematic Paleontology

Family Erisocrinidae Miller, 1889

Genus *Endelocrinus* Moore and Plummer, 1940

Endelocrinus **murrysvillensis**, new species

Figures 1, 2

diagnosis: Dorsal cup pentagonal in outline, low, truncate, and bowl-shaped, approaching that of *Endelocrinus grafordensis* Moore and Plummer in size and in the slight convexity of the basal and radial plates. Basal concavity about half

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the height of the cup, with basals composing most of its wall. Pits at distal extremities of basals. Anal X large, wider than long, almost entirely within dorsal cup, with wide distal facet. Primibrachs spinose. Uniserial structure of arms persistent beyond juvenile stage. Ornamentation fine, granulose.

HOLOTYPE: Carnegie Museum No. 28957.

OCCURRENCE: Brush Creek Limestone, Conemaugh Group, Pennsylvanian.

LOCALITY: Outcrop in excavation on north side of U.S. Route 22, at the Allegheny-Westmoreland County boundary line just west of Murrysville, Pa.

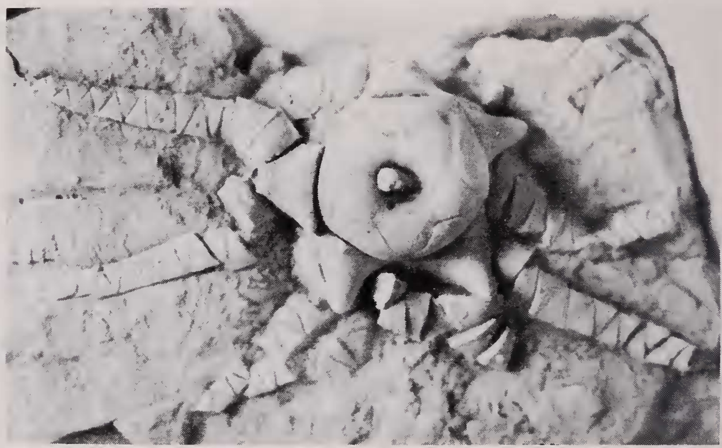

Fig. 1. *Endelocrinus* ***murrysvillensis,*** new species. Dorsal view of the crown in the position in which it was found. Enlargement approximately twice natural size.

DESCRIPTION: The crown representing the holotype is fairly complete. Most of the arms are preserved, at least in part, although somewhat dislocated. The crown height is more than twice the width of the dorsal cup. Part of the stem is attached to the dorsal cup and is composed of equal-sized segments, with a round or sub-round lumen.

It was possible to remove the dorsal cup for study without damaging the specimen. The cup has suffered some compression, but there is no serious displacement of the plates. The cup is low, truncate, and bowl-shaped; in dorsal and ventral view it is more sharply pentagonal than in *Endelocrinus* generally, and the angles of the pentagon occur at the interradial sutures. A deep funnel-like concavity, which extends upward to at least mid-height, is found at the base. At the basal plane the concavity occupies about half the width of the dorsal cup. The full height of the concavity is not determinable because part of the stem is preserved within the depression.

The infrabasals are somewhat petal-like in shape distally and slope downward steeply from their place of origin at the apex of the concavity. The stem is nearly three-fifths as wide as the infrabasal circlet. Three of the infrabasals show in the holotype, but the left posterior and the left anterior infrabasals are concealed by the stem, which has been displaced to the left side.

Proximally, the five basals constitute most of the wall of the basal concavity, and they slope rather abruptly downward from their contact with the infrabasals. Within the concavity they are moderately concave from side to side. Beyond the concavity the basals spread out, petal-like, comprising the dorsal and part of the dorso-lateral surfaces of the cup. The posterior basal is truncated for the reception of anal X. Distally these plates are slightly convex from side to side, but more convex along their length. However, there is fairly uniform curve to the distal tip, rather than the "subvertical slope" noted by Moore and Plummer (1940: 297) in their description of *Endelocrinus fayettensis* (Worthen). In their lack of strong convexity, the basals of *Endelocrinus murrysvillensis* resemble those of *Endelocrinus grafordensis* Moore and Plummer.

The pits at the angles of the plates, characteristic of *Endelocrinus,* are best shown at the distal extremities of the basals of *Endelocrinus murrysvillensis.* There is little indication of the pits at the proximal extremities of the radials.

In longitudinal profile the five radials curve outward to the arcuate area adjoining the articular facet, then sharply inward to the facet. The radials are nearly twice as wide as long, the arcuate areas of these plates are much less bowed than those of *Endelocrinus fayettensis* (Worthen), and the plates are less convex from side to side. The interradial sutures are not in furrows. There are indications of furrows

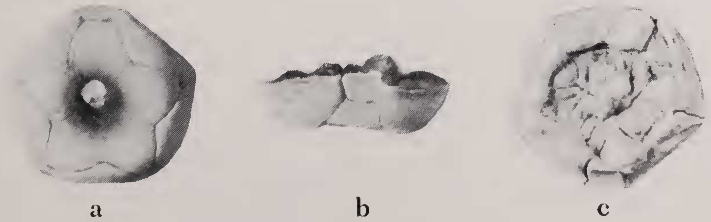

Fig. 2. *Endelocrinus* ***murrysvillensis,*** new species. Dorsal cup in (a) dorsal, (b) posterolateral, and (c) ventral views. Enlargement approximately twice natural size.

along the sutures between the basals and the radials, but the boundaries between these plates appear more evident mainly because of displacement resulting from compression.

At the articular surface the transverse ridge is denticulate and extends the full width of the radial plate. The outer ligament area is bordered by an outer ridge, not as wide as the transverse ridge, which sags in an arcuate course below the transverse ridge and encloses a slit-like ligament-pit furrow. Within this furrow is the short, elongate ligament pit.

The inner ligament area is relatively narrow and slopes outward from the tips of the somewhat angular lateral lobes. The lateral ridges are sinuous and the adsutural slopes widen adjacent to the lateral lobes. These slopes are gentle and there appear to be incipient ridges flanking the interradial sutures. The intermuscular notch is distinct and the intermuscular furrow is bounded by low ridges which delimit shallow basins in the muscle areas adjacent to the furrow. The lateral furrows are notch-like and extend obliquely from the ends of the transverse ridge toward the shallow basins in the muscle areas, but stop short of the basins.

Anal X is a distinctive and rather large plate. The only other species of *Endelocrinus* with anal X approaching this type is that described by Strimple (1949: 24) as *Endelocrinus petalosus.* The plate is wider than it is long, and, as in the Strimple species, lies almost entirely below the summits of the radials. But it is not bulbous, as in that species. Its shape is that of a truncated wedge, widest above. Below it rests on the posterior basal, and laterally it is flanked by the two posterior radials. It extends above the radial circlet on the right, where a short side makes contact with the right posterior primibranch. The wide distal facet is about as long as the facets of the adjoining radials.

What is evidently a second tube plate has fallen from its place on the superior face of anal X and now rests partly in the body cavity. This plate is rectangular and wider than it is long. The facet that rested on anal X is mostly hidden from view, but must have extended the full width of the plate. The superior face bears facets for contact with an additional plate or plates, and the right superior corner is also beveled for junction with another plate. Within the body cavity there are a few small dissociated plates, possibly tegminals.

The five primibrachs are axillary, each bearing two arms, making ten arms in all. The anterior primibrach is apparently the largest, as in *Endelocrinus fayettensis* (Worthen) and *Endelocrinus grafordensis*

Moore and Plummer. The right posterior primibrach is damaged distally and its full length cannot be determined. These plates are quadrangular and wider than they are long, but much more delicately constructed than the stout, robust primibrachs of *Endelocrinus fayettensis* (Worthen). They bear short spines, but the spines are longer and more slender than the primibrach spines of Worthen's species. In longitudinal profile, the surface of a primibrach of *Endelocrinus murrysvillensis* tends to be gently concave from a point a little above the base to the tip of the spine. In *Endelocrinus fayettensis* (Worthen) the profile may show some concavity in the midsection but it is convex or flattened below. The lateral slopes from the spines are also rounder and steeper in the Worthen species.

The anterior primibrach was removed from the specimen for study of its sutural and articular surfaces. The sutural surfaces of the plate are fairly narrow for most of their length, but expand rather abruptly as they approach the surfaces that articulate with the secundibrachs. The facet that articulates with the radial is inclined at an angle of about 67 degrees to the axis of the spine. This facet bears a denticulate transverse ridge which is prominent in its midcourse but obscure in its lateral reaches. The outer ligament area slopes upward from the transverse ridge. It resembles that of the radial and bears a similar slit-like ligament pit within the furrow. On the inner articular surface the lateral ridges become indistinct as they approach the lateral lobes. The adsutural slopes are moderate and wide, with their greatest width at the angle where the sutures bend obliquely inward in keeping with the expanding sutural surfaces. The intermuscular notch is distinct and somewhat V-shaped. The intermuscular furrow is bordered by ridges that delimit shallow basins in the muscle areas, and on the inner side leads into the ambulacral furrow. Faint oblique ridges extend inward from the extremities of the transverse ridge.

On the inner side of the primibrach, between the proximal and distal articular facets, is found the broad, deep ambulacral furrow, the floor of which is well rounded. Its walls are initially steep, but grade out into bulbous areas that intervene between the furrow and the lateral faces.

The primibrach surface that articulates with the secundibrachs is divided into right and left facets by a strong denticulate ridge. Each facet also bears a denticulate transverse ridge separating the inner and outer articular surfaces, as in the radials. The outer ligament-pit furrows are shallow and sag below the transverse ridges. The outer ridges bounding these furrows meet at an angle above the primibrach spine. The furrows terminate before the ridges converge, and each furrow bears a ligament pit situated a little less than halfway from this termination to the furrow's opposite end. Each inner ligament area shows a wide muscle area sloping upward to the tip of the lateral lobe and rather sharply separated by an intermuscular furrow from a very limited muscle area adjacent to the ridge that divides the secundibrach facets. The intermuscular furrow is directed toward the outer ligament pit, from which it is separated by the transverse ridge.

The first secundibrachs are subquadrate, actually more so than those of *Endelocrinus fayettensis* (Worthen) and *Endelocrinus grafordensis* Moore and Plummer. By removing the anterior primibrach I suceeded in exposing the proximal articular surface of the first secundibrach of the left arm of the anterior ray. The external ligament pit is located at about a third of the width of the plate, measured from the side adjacent to the primibrach spine. The inner articular surface is fairly wide and rounded on the left side, where it contacts the muscle area of the left side of the distal facet of the primibrach.

In the left posterior ray, the distal surface of the first secundibrach of the left arm is exposed. The features of the articular surface are very faintly shown, but they appear to include an outer crenulated area and a low transverse ridge with an external ligament pit situated on the external side of the midline of the ridge. On the inner ligament area a furrow similar to the intermuscular furrow of a radial extends toward the external ligament pit, separating two low surfaces that resemble muscle areas.

The succeeding secundibrachs are subcuneate in the proximal portions of the arms, becoming cuneate distally. There is no indication of biserial arrangement. The arms taper gradually to their extremities. The left arm of the left posterior ray shows 18 secundibrachs, and appears essentially complete. The arms are slightly rounded externally and flattened along the sides. A few slender pinnulars are preserved, but no complete pinnules.

Plates of the dorsal cup and arms show fine granulose ornamentation, barely visible at a magnification of 10 X. Somewhat coarser granulose ornamentation also characterizes the plates of *Endelocrinus fayettensis* (Worthen). The holotype of this was lent to me through the kindness of the Illinois Geological Survey, and I might note that the latter specimen preserves a few pinnulars similar to those found in *Endelocrinus murrysvillensis.*

Measurements of the holotype, in millimeters, are given below. Measurements of the dorsal cup are in accord with the definitions of Moore and Plummer 1940: 24-27).

Height of crown	26.0*
Height of dorsal cup	4.0*
Width of dorsal cup	12.0*
Ratio of height to width	.33
Width of body cavity	7.5
Height of basal concavity	2.0**
Width of basal concavity	6.5
Width of infrabasal circlet	2.4
Width of stem	1.5
Height of proximal margin of basal above basal plane	1.6
Height of distal margin of basal above basal plane	1.4
Length of basal	5.0
Width of basal	4.0
Length of radial	4.5
Width of radial	7.0
Length of suture between basals	2.5
Length of suture between radials	2.0
Length of anal X	2.0
Width of anal X	2.5
Length of tube plate	1.8
Width of tube plate	2.2
Length of anterior primibrach	5.0
Width of anterior primibrach	6.3
Length of spine, anterior primibrach	2.5

DISCUSSION: Among the species of *Endelocrinus* in which the arms are known, there is wide variation in arm structure which can be summarized as follows: (1) arms uniserial throughout, as in *Endelocrinus murrysvillensis*—possibly the same condition also holds true for *Endelocrinus matheri* (Moore and Plummer); (2) arms composed of brachials at an intermediate stage between the uniserial and "normal biserial" condition (Grabau, 1903: 290) as in *Endelocrinus bransoni* Strimple; (3) arms uniserial in the lower one-third of their length, but biserial above, as in the type of the genus, *Endelocrinus fayettensis* (Worthen), and in *Endelocrinus grafordensis* Moore and Plummer; and (4) arms essentially biserial throughout their length, as in *Endelocrinus undulatus* (Strimple). Such marked variation in arm structure in species otherwise quite similar leads one to suspect strong-

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*Approximate
**Estimated

ly that at least part, and perhaps all, of the above sequence constitutes a series of ontogenetic, rather than phylogenetic stages.

A possible explanation of these variations in arm structure among specimens of *Endelocrinus* may be found in the observations of Wachsmuth and Springer (1897: 704), cited by Grabau (1903: 296), that in *Platycrinites hemisphericus* (Meek and Worthen) biseriality occurs late in life. The ontogeny of various species of *Endelocrinus* may have followed a course similar to that of *Platycrinites hemisphericus,* with the uniserial condition persistent beyond the juvenile stage, and biserial arm structure may have been attained later in life.

In this connection, the species *Endelocrinus undulatus* (Strimple) is of special interest. Strimple (1961,1962) made this species the genotype of a proposed new genus *Tholiacrinus,* based on surface ornamentation, but I feel that in this he has insufficient grounds for establishing a new genus. In most respects the species seems to be assignable to *Endelocrinus,* except that the arms are apparently biserial throughout, as in *Delocrinus.* However, only the tumid plates of the dorsal cup and the characteristic *Endelocrinus* pits relate the species to the genus *Endelocrinus* as it was defined by Moore and Plummer (1940: 296). Previously the completely biserial arms of *Delocrinus* have been regarded as constituting the principal distinction between that genus and *Endelocrinus.* If, in *Endelocrinus* generally, biserial arm structure was attained late in the life of the individual, this in itself might constitute a basis for generic distinction from *Delocrinus.* In any event, it would explain the presence of fully biserial arms in *Endelocrinus undulatus* (Strimple).

ADDENDUM

Since this article was submitted for publication Lane and Webster (1966) have called attention to the lack of uniform biseriality in their Permian species *Stellarocrinus cuneatus,* and have contrasted the condition in their species with biserial construction of the arms closer to the dorsal cup in Pennsylvanian species of *Stellarocrinus.* In addition they state (*ibid.,* p. 24) "Because many other features of the new species denote close relationship with *Stellarocrinus,* previously known only from the Pennsylvanian, one must postulate that evolution has been in the development of cuneate uniserial brachials from ancestral biserial arms."

If this was actually the course of arm evolution in *Stellarocrinus,* then the partly biserial arm structure of the Triassic genus *Encrinus* may have been derived in the same way. Furthermore, if it can be determined that in *Endelocrinus* full biseriality was prolonged until later and later in the life of the individual, then it seems reasonable that in time the capacity to attain full biseriality eventually would have been lost entirely, and the condition found in *Stellarocrinus cuneatus* and various species of *Encrinus* would also have characterized fully adult specimens of *Endelocrinus*. Such a trend, if demonstrable, would indicate that neoteny has been a factor in the evolution of crinoid arm structure. If this has been the case, the possibility exists that some crinoids with completely uniserial arms might have been derived from ancestors with biserial arms.

REFERENCES CITED

GRABAU, A. W.
1903. Notes on the development of the biserial arm in certain crinoids. Amer. Jour. Sci., (4) 16: 289-300.

LANE, N. G. and G. D. WEBSTER
1966. New Permian crinoid fauna from southern Nevada. Univ. California Pub. in Geo. Sci., 63: 9-10, 24-26.

MOORE, R. C. and F. B. PLUMMER
1940. Crinoids from the Upper Carboniferous and Permian strata in Texas. Univ. Texas Bull. 3945: 1-468.

STRIMPLE, H. L.
1949. Crinoid studies, pt. 7. New species of crinoids from southeastern Kansas. Bull. Amer. Paleont., 32: 22-27 (272-277).
1961. Late Desmoinesian crinoids. Oklahoma Geol. Surv. Bull. 93: 6-135.
1962. Tarachiocrinus and Tholiacrinus. Oklahoma Geol. Notes, 22 (5): 135-136.

WACHSMUTH, C. and F. SPRINGER
1897. The North American Crinoidea Camerata. Mem. Mus. Comp. Zool., 20: 1-360; 21: 361-837.